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# THE EDUCATION AND TRAINING OF WATER PLANT OPERATORS IN TEXAS[1]

By Lewis O. Bernhagen[2]

The State of Texas, as we all know, is a domain vast in size. It is a state of magnificent distances. No one, however, can really appreciate the great area embraced within the boundaries of this commonwealth until he has had occasion to traverse the state in the several directions. Austin, the capital is situated not far from the geographical center, yet the distance by rail to the farthest water plant in the panhandle is more than 1000 miles. Reference to a map will indicate that the area of Texas is more than six times that of Ohio, more than five times that of the State of New York, and nearly six times that of Pennsylvania. It is a state in which the inhabitants were, until very recent years, devoting all of their energies to stock raising and agriculture. San Antonio the largest and also one of the oldest cities has at present less than 170,000 population. I mention these circumstances in order to bring before my readers the fact that the state's population of nearly 5,000,000 is distributed, comparatively speaking, among a great many small cities and towns.

The history of water purification in Texas dates back only a few short years. Up until about 1911 very little attention or thought had been given the matter of municipal water purification. About that time, however, serious difficulties were encountered by a number of cities which were compelled to take their water from surface sources. No state law existed which restrained, to any great extent, municipalities, industries, or private individuals from contaminating or polluting the lakes and streams of the state. This fact naturally led to very serious consequences. During the year 1918 the estimated number of deaths due to typhoid fever was 2000 while that of other water borne diseases was 6000. The number of cases of typhoid per 10,000 during this year was 44.

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[1] Presented before the Cleveland Convention, June 8, 1921.

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In 1911 the State Legislature passed a bill creating the State Board of Health. As a great majority of the legislators were from rural communities and these men were not vitally interested or did not understand and appreciate the urgent necessity of stringent regulations pertaining to the safeguarding of the public health, the bill as enacted was of a rather unsatisfactory form. It did not provide for sufficient machinery to enforce the law, especially insofar as the sanitary protection of surface water supplies was concerned. In the same year, "The Sanitary Code for Texas" which was adopted by the Texas Board of Health, was enacted into a State statute. The statute did not include, however, anything of particular value which might be used to remedy the municipal water supply situation.

The bill which created the State Board of Health, provided for the establishment of a general laboratory and for the maintenance of a laboratory technician. It also provided for the appointment of a sanitary engineer or inspector whose proposed activities were defined as follows: "It shall be the duty of such inspector to conduct such inspection as required by the board and the president of the board, and to assist in the enforcement of all sanitary and quarantine laws of the State and to perform such other necessary services as may be prescribed by the president of the board." It will readily be seen that with the multitudinous duties assigned to him, the inspector had very little time to devote to solving water problems. Those of you in the audience who are from the newer or younger states, where the personnel of the engineering sections of the State Boards of Health are limited to two or three engineers, will realize the trials and tribulations of our lonely inspector, especially if you will also contemplate the vast area he was supposed to cover.

In 1911 Texas boasted four water filtration plants serving water to a total population of slightly more than 117,000. The plants had a combined capacity of 20,000,000 gallons. Following is a table of the water supply situation in the state at the beginning of the present year.

All supplies serving a population of 1,863,068 with approximately 121,229,520 gallons daily.

A consideration of the table will indicate that 860,000 people or 46.1 per cent of the urban population is now served daily with 55,900,000 gallons of water filtered and disinfected at 25 different plants and that 113,000 other persons, representing 6 per cent of the urban population, living in 23 different cities and towns are supplied daily with 7,345,000 gallons of disinfected water.

A further study of the data will show that there are at present 294 municipalities that obtain water from ground sources, that is from either wells or springs. We all know that, generally speaking, the supply of water from an underground source is usually limited in quantity. This has been the sad but actual experience of a number of our Texas towns during the past two or three years. As the population increases the quantity of water consumed increases proportionately and the available supply usually decreases at an inverse ratio. An appreciable number of municipalities are finding themselves in the unenviable position of finding it necessary to seek other sources of supply, meaning in nearly all cases that surface water will have to be resorted to, with the attendant necessity of filtration and disinfection, or at least disinfection.

Number of municipalities served by public water supplies. 370
Total urban population served by public water supplies... 1,863,068

| SOURCE OF SUPPLY | NUMBER OF PLANTS | METHOD OF PURIFICATION | POPULATION SERVED | GALLONS USED DAILY | PER CENT OF URBAN POPULATION SERVED |
|---|---|---|---|---|---|
| Surface water supplies. | 76 | | 766,000 | 49,790,000 | 41.1 |
| Surface water supplies. | 22 | Filtered and disinfected | 650,000 | 42,250,000 | 34.8 |
| Surface water supplies. | 12 | Disinfected only | 59,000 | 3,835,000 | 3.1 |
| Surface water supplies. | 42 | Not treated | 55,000 | 3,575,000 | 3.0 |
| Ground water supplies. | 294 | | 1,097,000 | 71,305,000 | 58.8 |
| Ground water supplies. | 11 | Disinfected only | 54,000 | 3,510,000 | 2.9 |
| Ground water supplies. | 271 | Not treated | 797,000 | 51,805,000 | 42.8 |
| Mixed ground and surface supplies........ | 12 | | 246,000 | 15,990,000 | 13.2 |
| Mixed ground and surface water supplies.. | 3 | Filtered and disinfected | 210,000 | 13,650,000 | 11.3 |
| Mixed ground and surface water supplies.. | 3 | Disinfected only | 10,000 | 650,000 | 0.5 |
| Mixed ground and surface water supplies.. | 6 | Not treated | 26,000 | 1,690,000 | 1.4 |
| From all sources....... | 25 | Filtered and disinfected | 860,000 | 55,900,000 | 46.1 |
| From all sources....... | 23 | Disinfected | 113,000 | 7,345,000 | 6.0 |

In 1919, the State Legislature increased the technical force of the Bureau of Sanitary Engineering of the State Board of Health to three engineers. One of them, the writer, was assigned to devote practically all of his time to the investigation and study of municipal water problems. A small portable laboratory, designed for field work, was fitted up. Standard solutions and such culture media as are usually required for routine work were also prepared and carried from place to place to be used in connection with the laboratory.

It is an unfortuante circumstance that the legislature has failed to provide traveling expenses for the engineers. All expenses incurred must be paid by the municipalties making the request for a visit of a representative of the Bureau of Sanitary Engineering. This procedure tends to prompt cities to delay asking for an engineer to assist them, a delay which is often most unwise. Most of the visits of the engineers were for the purpose of consulting with city officials as to the most suitable source of supply, the protection of such supply against contamination and the methods of treatment, together with the interpretation of results. Often, too, he was asked to teach the local operator in charge of the filtration or disinfection plant already established, the necessary laboratory methods, both chemical and bacteriological, required to control the proper application of chemicals to secure an effluent satisfactory from an aesthetic as well as a health standpoint, and finally, how to obtain such a result at a minimum cost.

It was our experience that the average filter operator of a small plant knows little of the fundamental principles underlying the successful operation of his plant. He has not the techincal knowledge required to operate the plant economically and to deliver potable and wholesome water to the consumers. He has insufficient laboratory equipment to do that part of his work properly. He has small faith in his technical ability, amd consequently does not enjoy the full confidence of the city officials or his employers in this respect.

After carefully considering the general situation relative to the water purification problems, conferences were arranged by Mr. V. M. Ehlers, Director of the Bureau of Sanitation, with Dr. C. W. Goddard, former State Health Officer, and the matter was gone over in detail. It was decided that, because of the fact that there are such a great many small water purification plants in the state operated by men with little or no technical training, the logical thing to do would be to establish schools where condensed short courses of subjects pertaining to water supply, water purification and distribution would be offered to all persons interested in these subjects. Further conferences were then arranged between representatives of the State Board of Health and members of the faculty of the University of Texas, and a program for an intensive two weeks course was outlined. It was agreed that the Bureau of Sanitary Engineering should formulate and carry out the publicity campaign to advertise the school, while the University was to furnish the laboratory space, technical supplies and equipment, class rooms, and most of the lecturers and laboratory demonstrators. This plan of coöperation proved a wonderful success. The schedule of classes included lectures and laboratory work in the fundamental principles of water chemistry and bacteriology. This work was made one of the major subjects and four hours per day were devoted to this work. Other subjects offered included lectures and demonstrations of meters and pumping machinery, filter plant operation, water sterilization, and boiler room economy. Lectures were also given on the protection of water supplies, legal responsibilities of water companies, geology of underground water-bearing strata, and determinations of key rate in insurance. This school was scheduled to be held during the first two weeks in February, 1920.

About six weeks before the opening day of the school the Bureau of Sanitary Engineering began its publicity work. This consisted of furnishing prepared articles to the newspapers throughout the state, setting forth the great need of more technical skill among water plant operators, and emphasizing the good which attendants at this course might derive, not only for themselves, but for the community in which they worked. Personal letters were directed to men over the state who were actually engaged in different features of water plant operation. Finally letters were sent to the city officials, city health officers, directors of chambers of commerce and influential persons, suggesting to them that they make an effort to have one of their local water works men attend the school, explaining in the letter the urgent need to have, at all water plants, men who were capable of examining water and to determine whether or not the water served to residents of the community was wholesome. A special effort was made to interest men in towns using surface water supplies and those contemplating the construction of filtration plants or sterilization equipment.

That the school was a success goes without saying. Twenty-four men registered for the course. No tuition of any kind was assessed.

The attendance would have been considerably larger had it not been for the fact that at that time there was a recurrence of the influenza.

It is really surprising how well the students mastered the subjects presented. They learned how to make alkalinity tests, using the various indicators ordinarily employed, residual chlorine examinations, and determinations of carbon dioxide, chloride and iron. They also learned how to sterilize glassware, to prepare media and to determine the number of bacteria in water and to make the presumptive test for B. coli. Besides these actual accomplishments they gained considerable information from the illustrated lectures, talks and demonstrations of the other subjects offered. Many of the men came to gain special knowledge concerning some certain subjects and these students were, of course, permitted to *specialize*. The important point that was impressed on all of them during their two weeks study was the fact that water treatment was a vast subject covering considerable areas of the fields of both chemistry and bacteriology. They were not permitted to leave the course with the feeling of the high school graduate, who thinks, "I know it all." All technical subject matter was presented to the students in the simplest form. Formulae and technical expressions were avoided as much as possible. As no suitable book for the presentation of this work was available, a sixty-two page pamphlet was written especially for the occasion. This booklet is now being distributed free of charge by the State Board of Health to all who apply for it.

A development of this first school of Water Plant Operators was the formation of the Texas Water Association. This is at present a live, going society of nearly 175 members, although only about 16 months old. The benign influence of such a society can hardly be overestimated. The united effort of an association of this kind, it is confidently hoped, will have a beneficial effect toward raising the standard of water plant operators and thereby increasing especially the efficiency of water purification plants.

Since the first school held in February, 1920, two other similar courses have been given. The second was held at the University of Texas, in January, 1921, while the third was given at Baylor University, Waco, in April, 1921. The State Board of Health coöperated with the institutions as it did at the first session. Each of these schools was a signal success. A number of students who attended the first course, returned for post graduate work at the following ones.

Too much cannot be said of the general good results obtained by the educational propaganda inaugurated by the Bureau of Sanitation of the State Board of Health, to create interest in the water works school. It seems that this publicity has made the people realize that more thought should be given to the quality and wholesomeness of the water served to municipalities. No less than 25 communities are at the present time approaching the stage when water purification plants will be built or where they are already under construction.

Considerable interest has already manifested itself in the meeting of the special session of the legislature which is to convene in July. A bill already drawn and supported by the Texas Water Works Association, will make the Water Plant Operators School a regular state institution, so to speak, and appropriates money for its maintenance. This act also provides for a licensing board of four members, one of whose duties will be to prescribe a standard of proficiency as to the qualifications of those engaged and of those who may engage in the operation of water filtration plants. The bill furthermore provides for the licensing of water purification plant operators. The proposed act is indorsed by many prominent legislators and has a good chance to be enacted.

In conclusion, permit me to state that the education and training of water plant operators as inaugurated in Texas, has marked an epoch in the advancement of the science of water purification in the state.

The writer is indebted to Mr. V. M. Ehlers, State Sanitary Engineer, for much of the data submitted in this paper.